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Title: Transuranic Waste Facility: Evaluation of Material-at-Risk Limits

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1 Executive Summary

The purpose of this analysis was to provide an evaluation and justification of the differences in the safety-basis parameters of Area G and the proposed TRU Waste Facility (TWF) in response to a request from the Los Alamos Field Office. Many of the differences in safety parameters stem from physical attributes such as facility location, size, and updated safety-basis requirements, etc. However, the primary safety-basis parameter that LANL and the Los Alamos Field Office can control for the proposed TWF is the required MAR limit. Based on the following analysis, LANL has proposed to reduce the overall facility MAR from 30,000 PE Ci[1] to 21,400 PE Ci, and the waste storage buildings from 4,550 PE Ci to 3,200 PE Ci. The recommendation balances program requirements, operational considerations, facility construction cost, and container costs. To implement the reduced MAR strategy above, the Los Alamos Field Office and LANL will need to work with WIPP to ensure two characterization/shipment campaigns are scheduled each year.

The analysis in this document included a review of historical trends and potential future scenarios in activity for enduring waste containers to define the expected normal operating range. The first part of the MAR analysis resulted in a newly defined range of activity of 10.5-18.0 PE Ci per DE[2] expected for the design life of the new TWF. However, for accident scenario analysis, containers will use the WIPP WAC limits because there are no other individual container controls. Specifically, accident scenarios involving less than the building MAR will use the 80-PE Ci WIPP-WAC limit for drums. The accident analyses are intended to bound the potential impacts, and are not intended to be based on normal operational ranges.

The Field Office also requested that LANL evaluate a potential reduction of the waste storage building MAR Limit by a factor of two to three. LANL used the newly defined MAR range of 10.5-18.0 PE Ci/DE to define upper and lower MAR boundary requirements using three containerization scenarios. The result of the analysis showed that the most probable scenario of future operations that balances costs, drum packaging efficiency, and shipment efficiency will routinely require the use of one-third to two-thirds of the MAR limit for each building. This result, paired with scenarios that could potentially provide short-term MAR increases, demonstrates that the MAR cannot be reduced by a factor as large as two to three, but can be reduced from 4,550 PE Ci to 3,200 PE Ci for waste storage buildings (a reduction of 30%).

The TWF PDSA submittal contained combustibility values for enduring waste that appeared relatively large compared to Area G. The analysis provided the basis for the initial combustibility values established in the PDSA. Although the recent data provided combustibility values that were much lower than the PDSA assumptions (27% versus 80% in PDSA), the analysis shows that there is variability in combustible loading over time. For safety-basis accident scenarios, the material composition distribution for waste containers will be included in the MAR requirement

[1] PE CI= Plutonium-239 equivalent curies
[2] DE= 55 gallon drum equivalent

by assuming all waste is combustible instead of applying a control for combustible loading. For operations and programs, it is better to assume 100% combustibles and maintain flexibility for waste generator containerization rather than to maintain a requirement for administrative controls of combustible loading. Controlling MAR through administrative controls is difficult for both the generator and waste management operations.

2 Introduction

The Los Alamos Field Office has requested that Los Alamos National Laboratory (LANL) provide an explanation on the differences in the safety parameters between Area G and the new Transuranic Waste Facility (TWF). Area G is currently providing the interim Transuranic (TRU) solid waste capability. The new TWF when completed will provide the LANL enduring TRU solid waste capability for the next 50 years. The Los Alamos Field Office completed an initial comparison of the key safety parameters of Area G and the TWF and is included as Attachment A. For consistency, the LANL justification and explanation of the difference in key safety-basis parameters will follow the Los Alamos Field Office comparison table. The primary focus of the LANL evaluation and justification is on the proposed Material-at-Risk (MAR) limits, drum activity loading, and waste composition distribution in the latest PDSA and their programmatic justification.

3 Facility Comparison

The facility comparison is based on information from the Area G Basis of Interim Operations (BIO) – ABD – WFM-001. Rev. 1.1 and the TWF Preliminary Documented Safety Analysis (PDSA) 102355-PDSA-0002, Rev 1. Area G is a limited-life facility that is 58 years old and located in Technical Area (TA)-54. TA-54 is 0.24 kilometers (km) from the public boundary. The new TWF should be completed in the 2016 timeframe and will be located in TA-63. TA-63 is 1.47 km from the public boundary.

The Area G capability is currently focused on MAR reduction and de-inventory of legacy waste volumes. Area G continues to support enduring program-generated waste as the sole TRU waste management capability but is on the path to full decommissioning in 2015 based on the Consent Order with the State of New Mexico, Department of Energy (DOE), and LANL. The new TWF will provide the enduring TRU receiving, storage, and characterization of solid waste capabilities as part of the enduring waste strategy at LANL.

The Area G capabilities were developed and have been updated as necessary, to manage both legacy and newly generated waste requirements. Area G currently manages over ten thousand drum equivalents (DE) and has a very broad range of capabilities (receiving, repackaging, processing, storing, characterizing, and disposing of low-level, mixed low-level, and TRU solid waste). The new TWF will have a narrower range of capabilities (receiving, characterization, and storage) for TRU solid waste. Although the enduring waste generation requirements are substantially smaller than the legacy volumes, the required capability for TRU solid waste cannot be a scaled down version of the Area G capability. The TWF as a capability must be forward looking and be able to meet the identified programmatic requirements over the facilities design life of 50 years, including contingency to address some level of programmatic variability over such a long time. Like Area G, the TRU solid waste that the new TWF will need to receive, store, and characterize will be in three types of containers: standard 55-gallon drums, pipe over-packs containers (POCs), and standard waste boxes (SWBs).

Table 1 is based on the Los Alamos Field Office initial comparison of Area G and new TWF safety parameters. An additional column has been added to provide a brief explanation of the difference between the two facilities' safety-related parameters.

The primary attribute of the new TWF that the Los Alamos Field Office and LANL are able to control is the MAR limits for the overall TWF and the specific waste storage buildings. The MAR limits were derived based on the identified programmatic requirements. The following sections evaluate and provide a programmatic justification of the proposed Material at Risk (MAR) limits, drum activity loading, and waste composition distribution.

Table 1: Comparison of Area G and New TWF and Explanation of Difference

Parameter	Area G (TA-54)	TWF (TA-63)	Justification for Difference
Age	58 years, limited life - until 2015	New Facility	
Distance to Public	0.24 km	1.47 km	Based on facility specific location
X/Q (sec/m^3) - for Max. Exposed Off-Site Individual (MEOI) ground level release	8.66E-04 sec/m^3	1.01E-04 sec/m^3	TWF includes a deposition velocity (DV) of 0.4cm/sec. The Area G BIO includes a DV of 1.0cm/sec. The Los Alamos Field Office has asked that site specific DVs be developed and it is anticipated that the Area G DV will become more conservative.
X/Q (sec/m^3) - for Collocated Worker (CW) ground level release	7.31E-03 sec/m^3	3.50E-03 sec/m^3	The TWF value taken from DOE-STD-1189. The Area G value was derived based on DOE-STD-5506.
Source to Dose Conversion Factor (DSF) [BR x DCF x X/Q] for MEOI	53.3 rem/PE-Ci	6.17 rem/PE-Ci	Lower value for TWF based on X/Q. The X/Q is takes into consideration the facility specific location.
DSF (BR x DCF x X/Q) for CW	450 rem/PE-Ci	213.7 rem/PE-Ci	Lower value for TWF based on X/Q value from DOE-STD-1189
Functions	Receive, process, store, ship, repackage, characterization, and dispose of LLW, MLLW, T, TRU waste	Characterize, store, intra-site shipping TRU waste	The new TWF has a narrower range of capability requirements. The RANT facility will still provide the enduring packaging/shipping capability for shipments to WIPP.
Facility container inventory	Above ground: ~15,000 TRU waste containers (2009).	825 DE normal ops, 1,240 DE with surge capacity	The TWF DE values were derived based on the programmatic requirements. The TWF waste volumes for standard waste boxes, pipe over packs are converted to DEs. The Area G volumes are driven by legacy waste and closure of Area G. The programmatic requirements are reevaluated in section 4.0 of this white paper.
Facility Rad Inventory (PE Ci)	150,000	21,400	The TWF PE Ci limit has been reduced from 30,000 PE Ci to 21,400 PE Ci based on the analysis in section 4.0 of this analysis.
Building Limit (PE Ci)	25,000	3,200	The TWF PE Ci limit for the waste storage buildings and characterization building has been reduced from 4,550 PE Ci to 3,200 based on the analysis in section 4.0.
Transport (PE Ci)	1,100	1,240	TWF value is based the new LANL Transportation DSA submitted to NNSA. The area G limit is based on the limiting accident for the Process Area which is the bounding case, not the transportation limit.

Table 1 (Continued): Comparison of Area G and New TWF and Explanation of Difference

Parameter	Area G (TA-54)	TWF (TA-63)	Justification for Difference
WIPP Compliant Containers Limits			
POC (PE Ci)	1,800	1,800	No Difference
SWB (PE Ci) direct loaded	560	560	
SWB (PE Ci) over pack with no single container exceeding 1100 PE Ci	1,200	1,200	
Drum (PE Ci)	80	80	
Drum (FGE)	200	200	
Waste Composition and Drum Loading			
Drum Median (PE Ci)	1		A detailed discussion of the waste attributes is provided in section 4. A comparison of the average PE Ci per container and combustible loading indicates observable variation over time. TWF will assume 100% combustible.
Drum Mean (PE Ci)	8		
Drum 95th Percentile (PE Ci)	31		
Drum Typical (PE Ci)		10.5-18.0	
Combustible	14%	27%	
Non-Combustible/Dispersible	13%	71%	
Non-Combustible/Non-Dispersible	73%	2%	

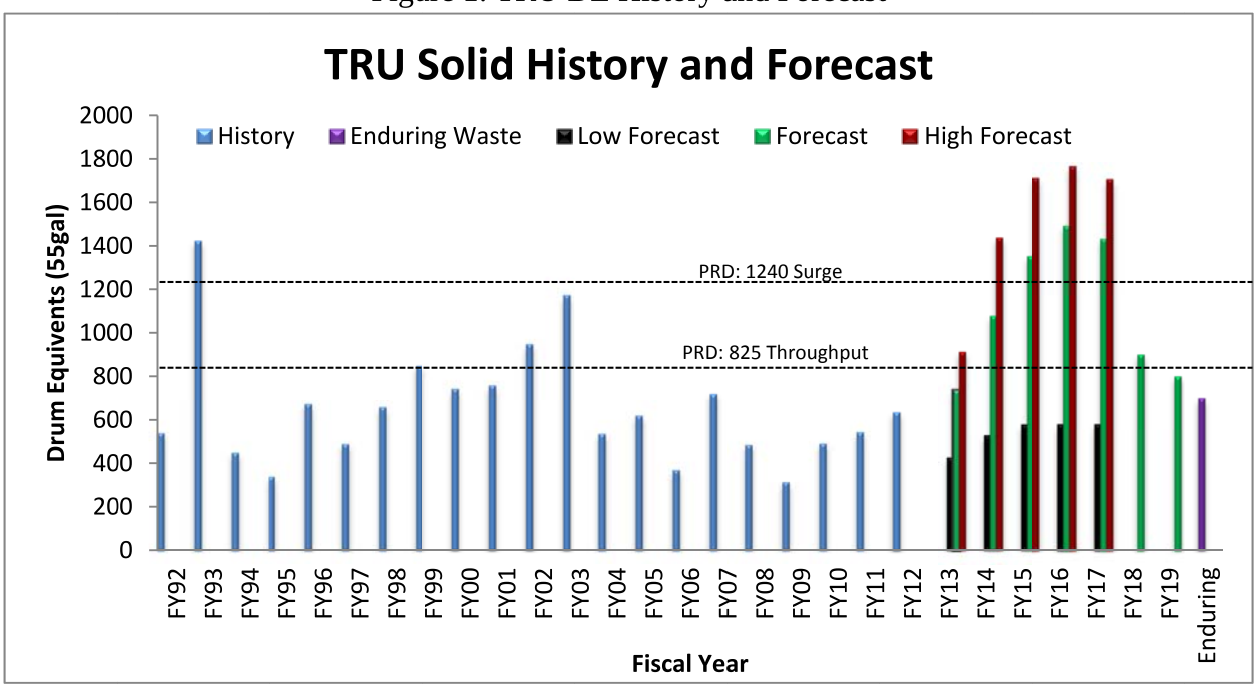
4 Evaluation of Programmatic Inputs to Facility Attributes

The Los Alamos Field Office has directed LANL to evaluate the potential to reduce the MAR limits by a factor of two or three. The following sections analyze forecasted waste volumes, drum activity loading, material composition, and packaging configuration scenarios to establish the minimum MAR requirement able to meet the identified mission need.

4.1 Throughput Capacity

The graphic in Figure 1 provides the historical TRU drum generation, current programmatic forecasts, and the TWF program requirements of 825 DEs annual throughput with a surge capacity of 1,240 DEs. The forecast data is based on the *LANL Solid Waste Forecast for Fiscal Years 2013-2017* report (LA-UR-12-27108). The forecast shows a relatively sharp increase in waste generation from 2013-2017 based on the planned Material Recycle and Recovery (MRR), and Advanced Recovery and Integrated Extraction System (ARIES) Steady-State Feedstock Program (SSFP) efforts. The MRR forecast is based on the accelerated vault clean-out efforts over the next five years and is anticipated to be completed by 2020. After 2020 the MRR scope will be substantially reduced. The ARIES programmatic effort is anticipated to have an increase effort through the mid-2030s. The forecasted enduring waste volumes include the decrease of the MRR vault cleanout and the continuing ARIES efforts. The enduring waste generation rates after 2020 is expected to be normal base-level production and are anticipated to be approximately 650-750 DEs (represented as 700 DEs in the graphic and remainder of analysis).

Figure 1: TRU DE History and Forecast



The TWF enduring capability of 825 DE with a surge capacity of 1,240 DE in the program requirement recognized that there would be fluctuations in TRU waste generation. The anticipated fluctuations in the forecasted FY 2016-Enduring TRU solid waste generation rates validate the 825-1240 DE design criteria.

4.2 Facility and Building MAR Requirements

The facility and building MAR requirements are affected by many factors such as material isotope, mass loading, container type, material matrix, frequency of shipments, and other variables. These attributes are evaluated and have been incorporated into the appropriate calculations to determine the appropriate MAR requirement. The TWF MAR limit is based on the limits for the five waste storage buildings, the characterization building, and the sealed-source building. The characterization building includes space for the temperature equalization for 20 drums and storage of 40 drums. The sealed-source building has a MAR limit of 2,200 PE Ci. Based on the analysis below, LANL is proposing the characterization building and each of the waste storage buildings have revised MAR limits of 3,200 PE Ci. The proposed revised Facility MAR limits of 21,400 PE Ci is based on the five waste storage buildings (3,200 PE Ci × 5), the characterization building (3,200 PE Ci), and the sealed source building (2,200 PE Ci). If the revised Facility MAR limits are accepted by the Los Alamos Field Office, the Project Programmatic Requirements Document (PRD) will need to be updated. The characterization building and sealed source building are limited in the amount of DE storage space relative to the five waste storage buildings. Thus, the programmatic evaluation and justification of the proposed MAR requirements is focused on the MAR associated with the five waste storage buildings.

4.2.1 Container Source-Term Loading and Waste Composition

This section provides results of historical data analyses and recent data analyses to define the expected source term (activity) loading range and waste composition assumptions for enduring waste.

4.2.1.1 Historical Analyses: Source-Term Loading and Composition

In July 2010 LANL completed an *Analysis of the TRU Waste Source Term Data* (see attachment 2). The analysis of data from July 2005 through June 2010 resulted in an average of 18.0 PE Ci per container. The analysis was based on 2,232 containers with a total of 40,245 PE Ci. The waste composition was also evaluated and determined to be 69.5% combustible, 27.2% non-combustible/non-dispersible, and 3.3% non-combustible/dispersible. The *Analysis of the TRU Waste Source Term Data* also provided similar analysis information based on actual data for 2009 and part of 2010, and forecasted data for the remainder of 2010 and 2011 with an average of 19.2 PE Ci per container. The waste composition was estimated to be 80% combustible, 15.8% non-combustible/non-dispersible, and 4.2% non-combustible/dispersible. The *Analysis of the TRU Waste Source Term Data* in conjunction with the identified out year programs formed the basis of the Facility MAR limits of 30,000 PE Ci and building limit of 4,550 PE Ci, and a facility inventory of 825 DE and surge capacity of 1,240 DE in the approved Program Requirement Document for the TWF Project. Although the facility inventory for the new TWF is put in terms of DEs, the waste to be stored and characterized will include SWBs, POCs, and standard 55-gallon waste drums.

It is important to note that as an initial point of reference the *Analysis of the TRU Waste Source Term Data* provided a summary of 1999-2008 data which had an average of 12.3 PE Ci per container. The analysis was based on 3,565 containers with a total of 43,749 PE Ci. The 1999-2008 data did not include any information on the waste composition. The report did conclude the following:

> *Analysis of the data over the past eleven years shows that there is no year to year consistency in TRU waste generation rates, container source terms, or waste matrix types. Therefore, using an "average" year is not likely to be a valid assumption for SB calculations. For example, average annual container source terms vary from a low of 5 PE Ci/container in FY2001 to more than 21 PE Ci/container in FY2007. This variability is due to year to year differences, the type and quantity of programmatic work being performed, facility availability, DOE discard authorizations, and other influences such as safety pauses.*

4.2.1.2 Recent Analyses: Source-Term Loading and Composition

Recently LANL performed an analysis on the two most recent years (FY2011 – FY 2012) of waste data. The analysis of this data resulted in an average 10.5 PE Ci per container. The analysis was based on 1,184 containers with a total of 12,316 PE Ci.

In addition, LANL performed an analysis based on current fissile gram loading targets for waste containers. The current target for loading TRU drums is a maximum of 150 grams of plutonium-239-containing materials or 15 grams of plutonium-238-bearing materials. These two loading levels have proven to be the optimal targets whereby nearly all drums meet certification, packaging, and shipping requirements to be dispositioned to WIPP. These two loading levels were used to calculate an expected PE Ci per drum equivalent loading factor.

The current waste forecast for plutonium-238 drums ranges from 15-50 DEs annually with a most likely estimate of 30 DEs/year. When the 15-50 DEs range was compared to the program requirement of 825 DEs and to the FY 2013-2017 DE forecast, the plutonium-238 DE fraction would be approximately 3% of all TRU DEs to be dispositioned. Using the weighted average of plutonium-238 and plutonium-239 drums and the respective target loadings, an average of 17.3 PE Ci per container was calculated. Table 2 compares the results of historical data analyses with the 17.3 PE Ci calculated for the current drum loading targets.

Table 2: Analysis of Average PE Ci Per Container

Source of Data	Data Timeframe	Average PE Ci Per Container
TRU Waste Source Term Data	1999-2008	12.3
TRU Waste Source Term Data	2005-2010	18.0
TRU Waste Source Term Data	Actual 2009/2010 – Forecast 2010/2011	19.2
Target Loading Calculation	2013 and beyond	17.3
Data Analysis TA-55 and CMR	2011-2012	10.5

The comparison of the average PE Ci per container for each data set indicates that there is observable variation over time with regard to activity loading of TRU drums, as expected based on historical trends. The average variation observed over the last 14 years of data, and documented in the analyses referenced above, is estimated to be representative of the variation of activity loading for enduring waste containers. This range (10.5-18.0 PE Ci per DE) in activity loading will be used to establish the MAR requirements for the five storage buildings at the TWF. Note that the 19.2 PE Ci limit was not selected as the top of the range because the analysis included forecast values as part of the calculation, where the 18.0 PE Ci was based on actual data.

The FY 2011 and FY 2012 waste composition was also evaluated and determined to be 27% combustible, 71% non-combustible/dispersible, and 2% non-combustible/non-dispersible. The following table compares the result of the recent analysis to the values listed in the PDSA submittal and the historical analyses results.

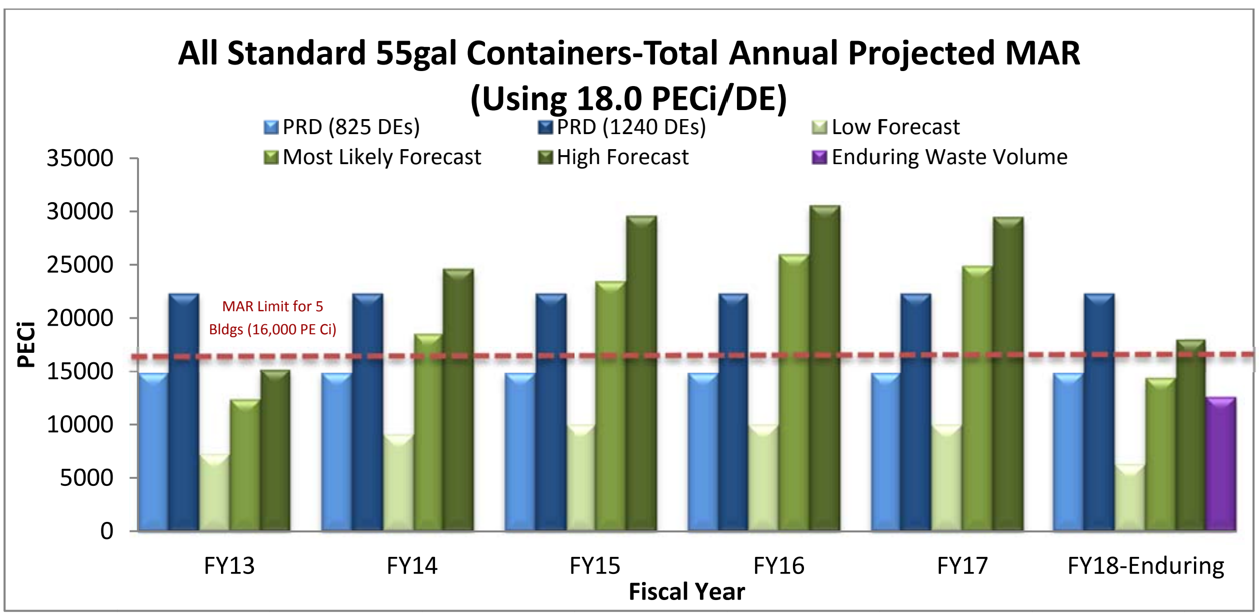
Table 3: Analysis of Waste Composition Distribution

Source of Data	Data Timeframe	Combustible	Non-Combustible/ Non-Dispersible	Non-Combustible/ Dispersible
TRU Waste Source Term Data	2005-2010	69.5%	27.2%	3.3%
TRU Waste Source Term Data ***(Used for PDSA)***	Actual 2009/2010 – Forecast 2010/2011	80.0%	15.8%	4.2%
Data Analysis TA-55 and CMR	2011-2012	27.0%	2.0%	71.0%

The historical analyses were used as the basis for the initial TWF PDSA submittal. Although the source database lacked the ability to provide finer resolution in material composition fidelity, the data and the analysis were the best information available. Specifically, the TRUCON code used to represent a variety of waste types was not defined sufficiently to differentiate combustible from non-combustible matrices, overestimating the fraction of combustible waste. *The recent* *implementation of the WCATS database at LANL has significantly improved the data fidelity with regard to waste composition.* Although the data fidelity differed between database sources, it is estimated that trends in observable variation of waste composition are real and will continue into the future. Without a longer history at the improved database resolution, it is impossible to predict more accurately what the average composition might be. The data does enable us to understand that there is a significant variability in waste composition. Thus, for the purposes of the MAR requirement analysis and safety basis calculations, all waste will be assumed combustible to reduce the use of administrative controls placed on waste containers. Thus, the analysis takes the most conservative path relative to the data variability seen in Table 3. Operationally and programmatically, attempting to control the combustible loading of waste generation to an administrative limit would make the waste management significantly more difficult and restrict generator flexibility. Instead, the MAR limit itself will be managed to account for a potentially 100% combustible matrix.

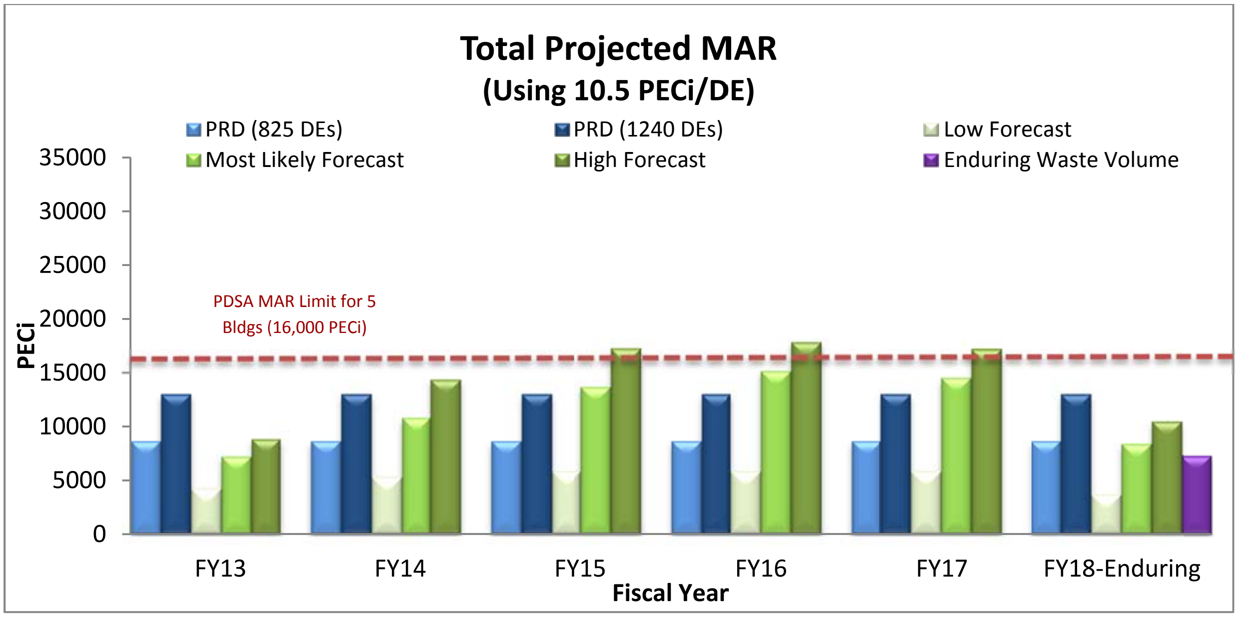
4.2.2 Upper Boundary: All Standard Containers MAR Requirement

The most conservative projection (i.e., upper boundary) for the MAR requirement is calculated based on the assumption that all items are packaged in containers that are part of the effective MAR, such as a standard waste drums (material in POCs does not contribute to the effective MAR). When the upper loading rate of 18.0 PE Ci/DE is multiplied by the DE throughput volumes in the FY 2013-2017 waste forecast (low, most likely, and high estimates), and the enduring waste estimate for TRU waste (700 DEs), the following graphic is the result.



The graphic defines the relationship between waste generation volumes and the future MAR requirements for new TWF absent any credit for safety-class containers such as POCs. This scenario defines the most conservative scenario for MAR requirement at approximately 30,500 PE Ci annually. The projection shows that in the short term, the requirements for MAR would exceed the annual total limit and require at least two shipment campaigns to WIPP per year to remain within proposed reduced MAR limits. The MAR limit appears to be at an appropriate level for the enduring waste forecast (which represents the average waste volumes into the future).

Alternatively, if the container loading rate of 10.5 PE Ci/DE is multiplied by the DE throughput volumes in the same FY13-17 (low, most likely, and high estimates) forecast and enduring waste volume estimate, the following graphic is the result.



This graphic shows that even at the lowest expected drum activity average loading of 10.5 PE Ci/DE and with no use of POCS, the variability in drum volume generation would drive the need for at least one WIPP shipment annually to manage MAR to ensure that even the high forecast generation rate is supportable.

Given the variability in the nature of the TRU solid waste and the need to meet all packaging and shipping requirements, the sole use of standard 55 gallon drums is not possible nor a reasonable planning basis for operations. However, this scenario provides a starting point from which the Facility MAR can be bounded. The next step in defining the appropriate Facility MAR requirement range is to include programmatic assumptions and other specific parameters affecting MAR calculations.

4.3 MAR Projections Affected by Container Configuration

The waste packaging configuration has the largest impact on the required facility MAR calculation after the source term. Specifically, waste packaged in POCs are not considered to be part of the effective overall TWF or single waste storage building MAR limits because POCs are considered safety-class containers. This section focuses on two scenarios of waste packaging configuration that establish the variability in the use of POCs (as compared to no POCs in the upper-bound analysis discussed previously), which will impact the MAR requirements over the 50-year design life of the facility. The two scenarios include a program-driven packaging configuration referred to as “normal operations” and a shipping optimization configuration of 80% POCs and 20% standard containers. The shipping optimization configuration is the scenario with the lowest reasonable MAR loading and thus will serve as the lower boundary for MAR requirements of the five storage buildings. Like the upper-boundary scenario, these two scenarios will assume that the average activity loaded in a drum is at the most 18.0 PE Ci/DE and at the least 10.5 PE Ci/DE.

4.3.1 Programmatic Inputs to MAR Loading

To evaluate how programmatic assumptions will impact the facility MAR requirements, it is necessary to define the sources of TRU waste and how the programmatic scope will drive waste packaging configurations. The TA-55 Plutonium Facility (PF-4) is the largest generator of TRU solid waste at Los Alamos. This facility houses programs in support of nuclear weapon component manufacturing, Pu-238 heat-source fabrication, nuclear non-proliferation, and nuclear material disposition. The following programs are the significant generators of TRU solid waste at TA-55: the Advanced Recovery and Integrated Extraction System (ARIES) capability, Plutonium Sustainment, Heat Sources, Science Campaigns, Engineering Campaigns, Directed Stockpile Work, Material Integrated Surveillance (MIS), and Material Recycle and Recovery (MRR).

The Steady State Feedstock Program (SSFP), which will use the ARIES capability to containerize metal and oxide through pit disassembly and conversion efforts, and the MRR program have proposed plans to increase work scope over the next five years. This increase in scope for both programs will significantly increase the volume of TRU solid waste generated at TA-55.The forecast for the TRU solid waste generated by the SSFP presumes that the Programmatic Environmental Impact Statement (PEIS) for the Surplus Plutonium Disposition (SPD) Program will be approved, making LANL the preferred site for an expanded pit disassembly and conversion mission. The LANL Steady State Project (SSP) is currently analyzing and planning for capacity and capability requirements around the preferred option known as “Alt-3L.” This option will not be executed on the initially projected timeline and thus has been renamed as “Alt-3Ld” (“d” for delayed). The low forecast for the ARIES capability in this section is based on current program activity scope of up to two metric tons of nuclear material dispositioned by 2018 which does not include any Alt-3L scope. The most likely and high forecasts for the ARIES capability are based on the Alt-3Ld project with two different assumptions in drum loading efficiencies. The differences in assumed efficiencies stem from restrictions placed on drum loading of beryllium-containing materials. Waste items with greater than 1% beryllium contamination reduce the standard 55 gallon drum fissile gram equivalent loading by 50% in addition to the shipping containment loading (i.e. TRUPACT-II) by nearly 70%. For this reason, POCs will be used to bring the fissile-gram-equivalent (FGE) loading for shipping containers into a more efficient range. However, the problem with using POC containers is that the volume is significantly less than that of a standard drum. Using POCs will potentially reduce the packaging efficiency of certain waste items by up to 75% relative to standard drums. It is estimated that up to 65% of all SSFP drums generated will require a POC packaging configuration.

The MRR Program has requested increased funding to accelerate the vault clean-out campaign. The forecast for MRR ranges from slightly elevated throughput levels to a fully accelerated program. There is a high probability that funding for a significantly accelerated program will be approved for LANL in the near future. The out-year funding is not certain, but is captured as part of the high forecast. The throughput from the accelerated program is a temporary increase in waste volume for TRU solid waste. The volumes are anticipated to return to much lower levels in the 2020 timeframe. The MRR items tend to contribute higher MAR drums than most other programs. However, because the MRR disposition materials do not contain significant fractions of beryllium, the program has more options for packaging configuration. Balancing the fill efficiency of each individual drum against the packaging efficiency of the shipping container (i.e., TRUPACT-II) is estimated to drive MRR to use POCs for approximately 50% of all waste items. This program is only expecting to put up to one-third of items into POCs after completions of the short-term acceleration of out-year scope.

The Heat Source program scope ranges from less than bench-scale production levels to full production. The approved limit for plutonium-238 mass loading into waste drums has increased over the last few years. The approved limit is currently at 15 grams with a proposal to be increased (to up to 60 g per container) for certain waste types in the next couple years as new calibration standards are available. The increases in plutonium-238 limits would reduce drum equivalent volume generation but would significantly increase the activity (PE Ci) loading per drum for this waste stream. The estimated use for POCs at the 15 gram loading limit is expected to be approximately 25% of DEs. At the 60 gram level, it is expected that all items would go into POCs.

The remaining programs at TA-55 are expected to generate waste annually at rates similar to recent years. Routine items stemming from normal operations are estimated to be packaged in mostly standard 55 gallon drums. An estimate of up to 30% of the remaining TRU waste generation at TA-55 is expected to be placed in POCs in the short term with expected trends towards 15-20% as part of long-term averages in enduring waste. The volume forecast for the Plutonium Facility TRU solid expected waste volumes is shown in Table 4.

Table 4 TA-55 Plutonium Facility TRU Solid Forecast

Units in 55 Gallon DE		FY13	FY14	FY15	FY16	FY17
ARIES	Low	65	65	65	65	65
	Most Likely	85	110	153	223	223
	High	94	148	204	298	298
MRR	Low	150	250	300	300	300
	Most Likely	350	600	800	900	900
	High	400	800	1,000	1,000	1,000
Heat Sources	Low	15	15	15	15	15
	Most Likely	30	30	30	30	30
	High	60	60	50	40	40
All Other Programs	Low	150	150	150	150	150
	Most Likely	175	175	175	175	175
	High	200	200	200	200	200
Total	**Low**	**380**	**480**	**530**	**530**	**530**
	Most Likely	**640**	**915**	**1,158**	**1,328**	**1,328**
	High	**754**	**1,208**	**1,454**	**1,538**	**1,538**

The CMR Building at TA-3 generates TRU solid waste at lower DE quantities than TA-55. The significant fraction of TRU solid waste stems from chemistry operations, inventory management, and vault clean-out efforts. The Confinement Vessel Disposition (CVD) Project is expected to come on-line in 2013 and will clean out materials from experimental containment spheres. Various scenarios of sphere cleanout are implied within the low and high ranges in the CMR forecast. The CVD Project is expected to operate through the time frame shown in this forecast. The TRU solid forecast for CMR, including the CVD Project, is shown in Table 5 It is estimated that POCs will be used for 66% of all DEs originating in CMR in the short-term because of the CVD Project. Upon completion of the CVD Project, it assumed that CMR will use POCs for up to 10% of TRU waste volumes.

Table 5 CMR TRU Solid Waste Forecast

Units in 55 Gallon Drum Equivalents	FY13	FY14	FY15	FY16	FY17
Low	20	20	20	20	20
Most Likely	40	100	130	100	40
High	70	130	160	130	70

Programmatically, two other sources of TRU solid waste are included. The first is the Offsite Source Recovery Program (OSRP) which does not truly generate waste items at LANL. Instead, this program recovers unused, spent, or unneeded radioactive sources used for operations such as well logging and brings them to LANL for disposal processing. This operation requires the use of LANL waste operation services and effects the DE space requirements for storage capacity of TRU solid waste. OSRP items are not expected to impact the MAR for the TWF. It is assumed that OSRP waste will be disposed of in POCs only or a future packaging configuration that will similarly not impact the effective MAR of the TWF. Thus, the OSRP volumes are excluded from all three MAR projections. The second additional generator source is the Radioactive Liquid Waste Treatment Facility (RLWTF) at TA-50. This operation generates new waste items from the sludge stemming from decontaminating radioactive liquids. This operation will continue to operate as long as TA-55 aqueous recovery operations generate radioactive liquid effluent. The RLWTF waste is expected to be staged within the 16,000 PE Ci limit and are not ever expected to be placed in POCs. These volumes are included in the MAR requirement projections. The forecasts for these two sources of TRU solid waste are shown in Table 6.

Table 6 OSRP and RLWTF TRU Solid Waste Forecast

Volume in 55-Gallon Drum Equivalents		**FY13**	**FY14**	**FY15**	**FY16**	**FY17**
OSRP*	Low	30	30	30	30	30
	Most Likely	50	50	50	50	50
	High	70	70	70	70	70
RLWTF	Low	2	5	5	5	5
	Most Likely	8	15	15	15	15
	High	20	30	30	30	30

*Not included in MAR calculations.

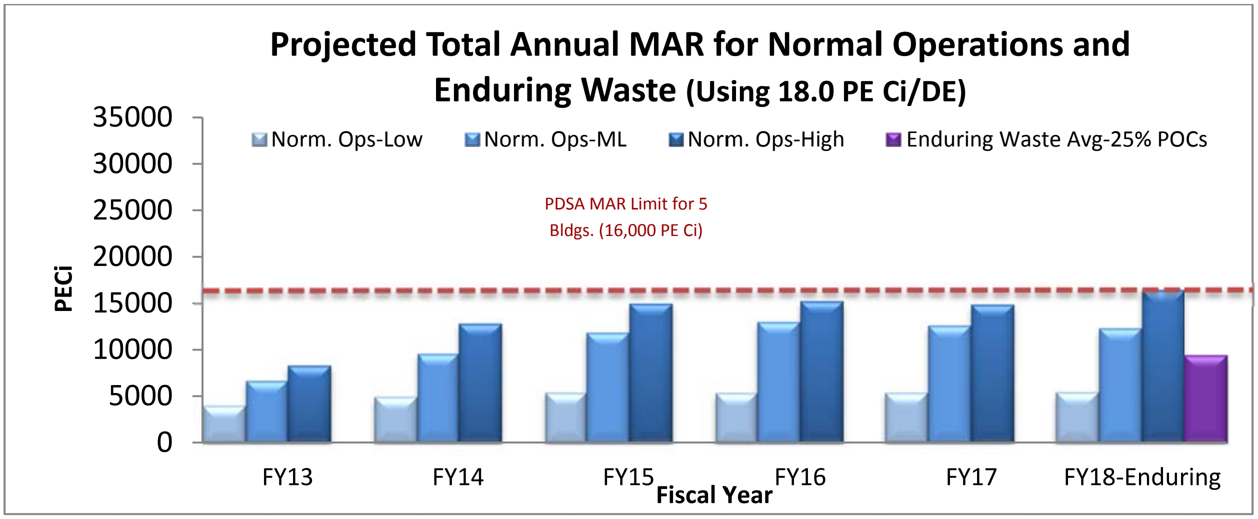
An average value for the use of POCs is calculated for the programmatic assumptions provided in this section. The average is calculated by multiplying the program specific waste volume forecasts against the assumed POC usage for each program described above. The weighted average calculated for POC use driven by programmatic scope and assumptions over the FY13-17 forecast is 52%. This average is applied in the expected MAR requirement projected for normal operations for the waste forecast into 2018. The enduring waste is assumed to have an overall average of 25% POC usage under normal operations in the long term.

4.3.2 Expected Range: Normal Operational MAR Requirement

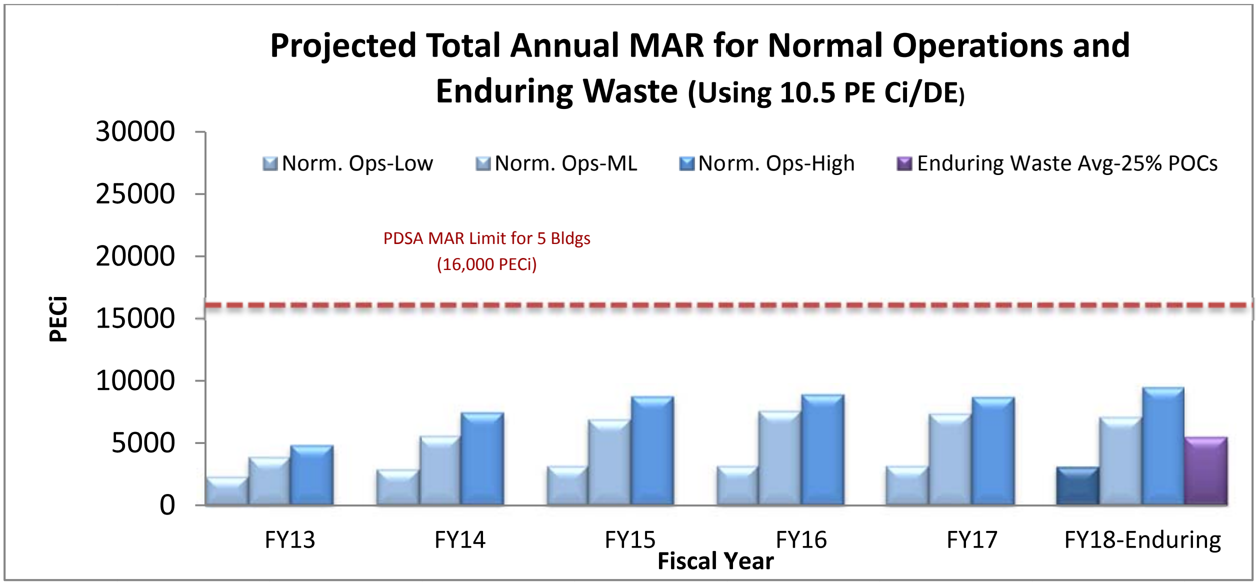
This section evaluates the projection of facility MAR for “normal operations” at the high activity loading range of 18.0 PE Ci and at the low activity loading range 10.5 PE Ci considering program-driven waste containerization decisions.

The use of POCs is estimated by subject matter experts and driven by the goals and scope of programs as discussed in the previous section. The efforts to manage the use of POCs by the programs represents “normal operations” with a focus on balancing packaging efficiencies of drums, shipping containers (TRUPACT-II), and costs. The current short-term packaging configuration assumptions for programs assumes that on average the programs will package waste using approximately 52% POCs. As programs such as MRR and SSFP are completed, it is estimated that long-term enduring waste will reduce the general use of POCs to approximately 25% of total DEs generated. The 25% POC usage is not expected to be reached until the early 2030’s.

The following graphic shows the projected total annual MAR for normal operations in the FY2013-2017 waste volume forecast range (low, most likely, and high) considering the use of POCs from program assumptions (52% POCs). The enduring waste MAR projection assumes 25% POC usage in the graphic after 2018 as enduring waste. The actual 25% usage is not expected to be reached until the early 2030s. The projected MAR for the graphic is based again on the use of 18.0 PE Ci per container. The normal operations waste and enduring waste MAR projection at the 18.0 PE Ci loading range show that significant fractions of the MAR limit (16,000 PE Ci) would be required annually even though POCs would be used for a significant portion of the waste. At minimum, one full shipment of waste to WIPP would be necessary to manage the MAR annually. However, based on the anticipated DE volumes, two shipments annually would be required.



The next graphic shows the projected total annual MAR for normal operations for the FY2013-2017 waste volume forecast range (low, most likely, and high) considering the 52% POCs and the projected enduring waste MAR assuming 25% POCs. The projected MAR for the graphic below is based on the use of 10.5 PE Ci per container drum loading.



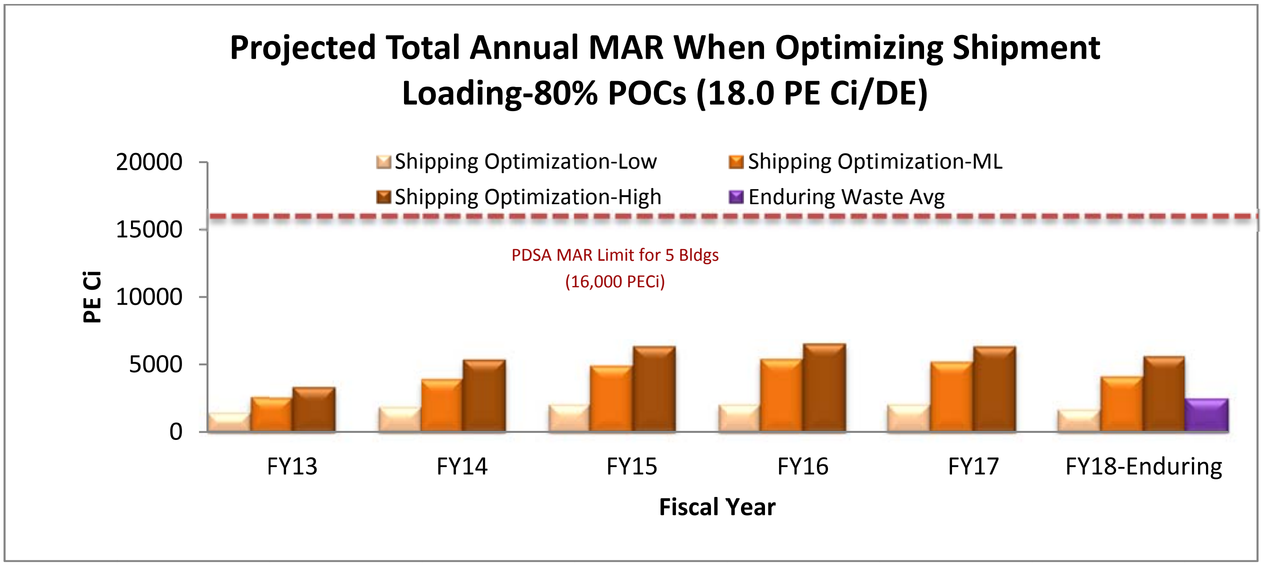
The normal operations waste and enduring waste MAR projection at the 10.5 PE Ci loading range show that the MAR for the five buildings would not exceed the limit (16,000 PE Ci) annually. At this drum loading level and DE throughput, only one shipment every 1-1.5 years would be required to manage the MAR. Once again, however, based on the anticipated DE volumes, two shipments annually would be required.

Given the variability in the nature of the TRU solid waste and the need to meet all packaging and shipping requirements, significant use of POCs is anticipated. From an operational cost perspective to programs, the long-term use of POCs will be minimized based on the substantial cost differential between standard 55-gallon drums and POCs. The container cost of POCs alone is over 30 times greater than a standard drum and the container has substantially less available volume. The assumption of 25% POC represents an increased cost of approximately $1 million per year to programs for enduring programs. Over the 50-year design life of the facility, the operational cost impact to programs is substantial.

4.3.3 Lower Boundary: Shipment Optimization MAR Requirement

The lower boundary scenario includes a greater use of POCs than the previous scenarios in this analysis. Hence, it is used to define the lowest possible MAR requirement (i.e., the lower boundary) expected for TRU solid waste.

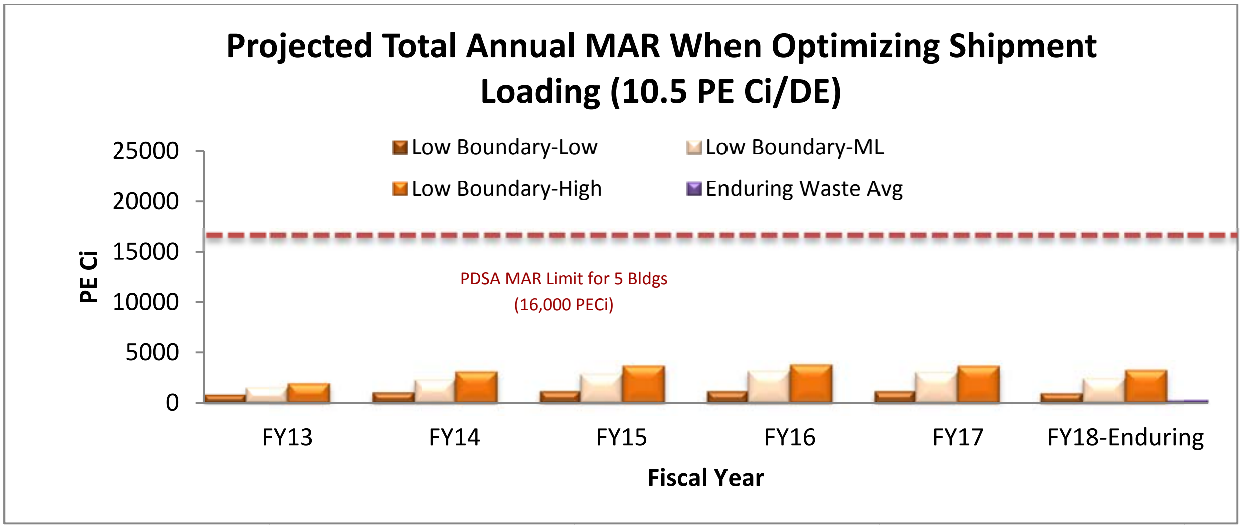
The section evaluates the MAR requirement when using a significant number of POCs to containerize waste as a strategy to maximize shipping container loading. Specifically, it focuses on the impact to the MAR requirements if TRUPACT-II loading takes precedence over all LANL packaging efficiencies including cost. The scenario assumes that 80% of TRU waste is containerized in POCs. The use of POCs for maximizing fissile gram equivalent (FGE) and activity PE Ci loading for each WIPP shipment has been discussed as a mitigation strategy to counter the restrictive loading limits of a TRUPACT-II (325 FGE limit) when using standard drums. In addition, similar to the use of POCs for mitigating TRUPACT-II loading limits, POCs might be used as a primary method for managing MAR at the TWF. The following graphic shows the projected total annual MAR for use of 80% POCs for the FY2013-2017 waste volume forecast range (low, most likely, and high) and enduring waste estimate. The projected MAR for the graphic is based again on the use of 18.0 PE Ci per container.



The use of 80% POCs has a significant effect on the effective MAR for the new TWF. At this level of POC use, the number of containers in residence would be the limiting factor for the facility rather than the 16,000 PE Ci limit for the waste storage buildings.

The following graphic shows the projected total annual MAR for use of 80% POCs for the FY2013-2017 waste volume forecast range (low, most likely, and high) and enduring waste estimate using 10.5 PE Ci per container.

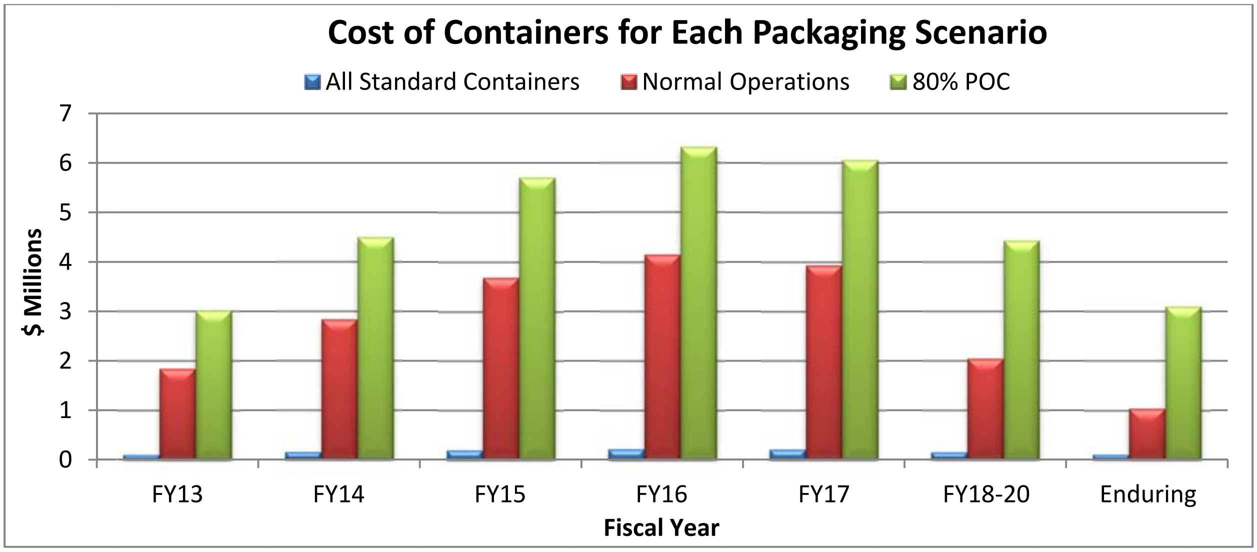
The lowest MAR requirement as part of this scenario is 861 PE Ci annually. This requirement defines the absolute lowest predicted MAR requirement across the three scenarios (all standard containers, normal operations/52% POCs, and 80% POCs) and will be considered the “lower boundary” for MAR requirement of the five buildings of the TWF. Like above, the number of containers would be the limiting factor, not the 16,000 PE Ci limit for the waste storage buildings.



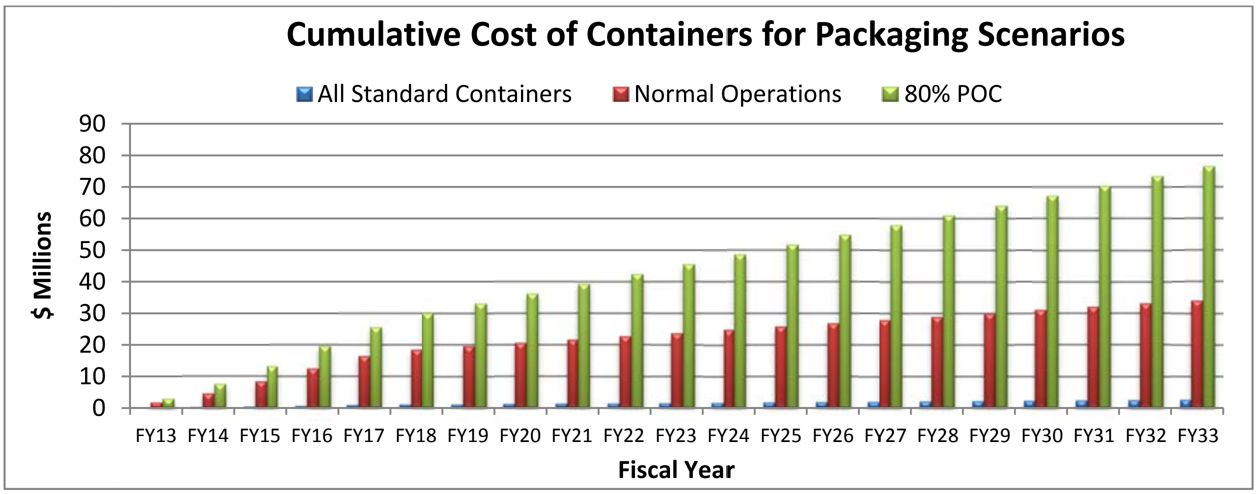
4.3.4 Container Configuration Cost Considerations

Based on the substantial cost difference between POCs and standard waste containers, the use of POCs for managing MAR and optimization of TRUPACT-II needs to be fully evaluated. The opportunity cost needs to consider both capital acquisition cost of the new facility and the program and operational costs over the life of capability.

The relative cost of a standard 55 gallon drum when compared to POC is more than a factor of 35. For instance, the POC procurement cost is $5,500, and a standard 55 gallon drum costs $155. In addition, the POCs cost more to ship, inspect, and use than a standard waste drum. Specifically, a POC cost $32 to ship and a standard drum cost $16. The difference is based on the fixed shipping cost of $3,200, where only 100 POCs can be placed on a trailer because of weight limits verses 208 standard drums. The receipt inspection for POCs verses standard drums is substantially more onerous. The inspection time for each POC is approximately 45min to an hour as compared to 5-10 minutes for each standard drum. The reason for this difference is the inspection of all pipes, shielding, and other additional components associated with a POC. From an operational perspective, POCs are heavier and provide significantly less volume for waste disposal, and often require additional or alternate nuclear material assay measurement techniques because of the thickness of the container components. Graphically, a comparison of the most likely DE forecast multiplied by the only the container cost for the POC and standard drum cost provides a simple estimate of the opportunity cost associated with the relative waste containment configurations of the three container scenarios. The comparison does not include the additional costs associated with shipping, inspecting, and increased cost associated with use of POCs vs. standard 55 gallon drums.



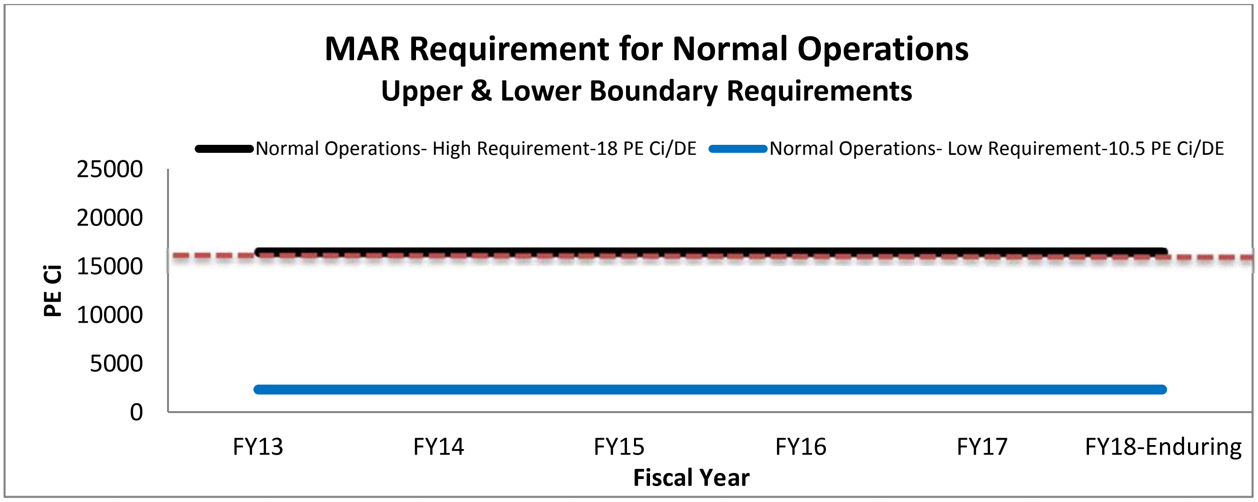
Shown below is the cumulative plot of the costs over 20 years of operation with the same scenarios.



Given the variability in the nature of the TRU solid waste and the need to meet all packaging and shipping requirements, the use of POC is anticipated to be required. However, from an operational cost perspective to programs, the long term 80% use of POCs would be cost prohibitive or at least require explicit recognition by program sponsors of the additional costs that will be incurred as a result of optimizing TRUPACT-II loading levels or managing MAR using POCs. The assumption of 80% POCs represents an increased cost of approximately $3.0 million per year to programs. Over the 50-year design life of the facility, the operational cost impact to programs would be increasingly onerous.

4.3.5 MAR Requirement Defined

The following graphic plots the expected upper and lower boundary requirement for MAR over the 50-year life of the facility based on normal operations. The boundaries that could be established based on using no POCs or using 80% POCs are not reasonable or practical. The normal operations represent the program-driven decisions made for the ultimate packaging of waste containers. In the short term, normal operational use of POCs is expected to be approximately 52%. For enduring waste the use of POCs is expected to be reduced to 25% upon completion of the SSFP project.



Waste management operations and programs will work together to ensure that the effective MAR is within the proposed MAR Facility limits through the use of POCs and the frequency of shipments to WIPP. The upper boundary for normal operations is based on the highest estimated DE volume in the forecast, at the expected highest average drum loading of 18.0 PE Ci/DE, with the assumed range of 25-52% of the waste packaged in POCs. The lower boundary for normal operations is based on the lowest estimated DE volume in the forecast, at the expected lowest average drum loading of 10.5 PE Ci/DE, with the assumed range of 25-52% of the waste packaged in POCs.

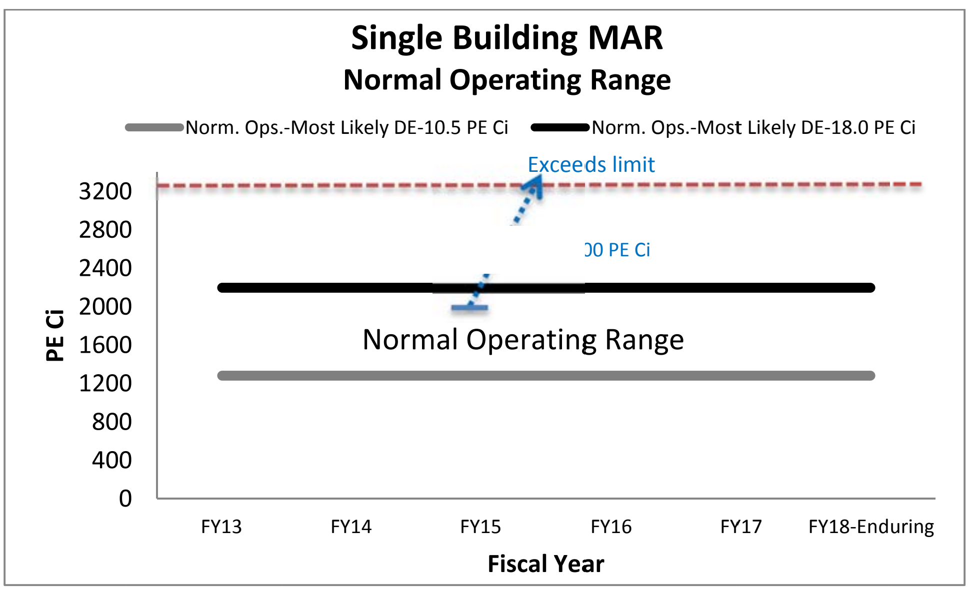
4.4 Additional Considerations

In addition to the facility throughput, container source-term loading, and container configurations, there are two other safety-basis parameters that are critical for establishing the MAR Limit for the new TWF. Specifically, the frequency of shipments to WIPP and variability in container activity loading are important in the determining required MAR Limits.

4.4.1 Variability in Container Activity

The proposed MAR Limit of 21,400 PE Ci represents the total MAR for the new TWF. The five waste storage buildings together have a limit of 16,000 PE Ci, and individually each storage building will have a limit of 3,200 PE Ci. Operationally, MAR has to be managed at the waste-storage building level. This means that when the MAR limit for a structure is reached, it can no longer store additional materials regardless of physical space usage or availability. Furthermore, the physical space unused cannot be transferred across the TWF, in effect, the available physical footprint associated with a building that has reached its MAR loading is no longer available as capacity. (However, having five independent facilities with independent MAR limits may allow for some optimization of waste staging to maximize the number of drums staged or the MAR in a particular building.) Programmatically, the requirements for MAR must include the variability of all waste container loading scenarios and not simply the average expected loading. The analysis so far has been based on average activity loading per DE. However actual size and loading of drums can vary significantly. For example, standard waste boxes (SWBs) allow for high MAR loading, up to1,200 PE Ci when overpacked, as compared to standard drums of up to 80 PE Ci. Because MAR will be managed at the building level, one high activity item like an SWB at 1,200 PE Ci can potentially use more than a 40% of the MAR limit for an entire building. High MAR waste becomes more of an issue when it cannot physically be put in a POC. For example, high-activity items stemming from Pu-238 operations during operational upgrades or D&D might not fit into the reduced volume of a POC. Thus the waste becomes part of the effective MAR for a building and can significantly affect the available capacity of the TWF, even though the number of DE is well below the storage limits.

The implications of high MAR waste containers can best be illustrated by plotting the projected MAR at the waste building limit of 3,200 PE Ci, versus the total 5-building limit of 16,000 PE Ci. If the MAR for the expected range of normal operations base on the most likely volume forecast with 52% POCs for FY2013-2017 is equally distributed in the five waste storage buildings, then estimated MAR for each storage building will range from one-third to two-thirds of the 3,200 PE Ci limit. The need to store one highly loaded SWB will change the building MAR Limit. The plot of this distribution for a single building is shown below.



Because MAR is managed and limited at the building level, anomalies in activity loading and packaging can significantly impact waste management flexibility and capacity. Reasonable programmatic scenarios include the need to store 1-2 maximally loaded SWBs (or several SWBs with relatively high loading), which will significantly impact one or more buildings already operating in the normal operational range.

Based on the analysis in this paper, the 3,200 PE Ci building limit is estimated to be effective for managing enduring waste volumes. However, LANL and NNSA will need work together to manage short-term increases in MAR from any future scenarios in increased mission, large-scale facility upgrades, D&D, or refurbishing efforts through the frequency of shipments to WIPP.

4.4.2 Shipment Frequency to WIPP

An important tool for managing MAR is the frequency of waste shipments to WIPP. The information provided in this analysis has shown that the variability in the amount of MAR or number of drum equivalents can utilize the capacity of the TWF at a level where one or more turnovers of inventory are required annually. The Laboratory plans to work with the NNSA to reach an agreement for a shipping frequency of two shipments a year for management of TWF DE capacity and MAR. If large D&D campaigns, increased programmatic scope, or other scenarios outside the assumption set of this document are encountered, LANL will work with NNSA to alter shipping cycles to the frequency necessary to appropriately manage waste volumes and MAR. The ability of increasing shipping frequency to WIPP is a key risk mitigation to help avoid the TWF becoming a limitation for programmatic operations.

5 Conclusion

The purpose of this analysis was to provide an evaluation and justification of the differences in the safety-basis parameters of Area G and the new TWF in response to the Los Alamos Field Office. Many of the differences in safety parameters stem from physical attributes such as facility location, size, and updated safety basis requirements, etc. and are summarized in Table 2. The primary safety-basis parameter that LANL and the Los Alamos Field Office can control is the MAR limit for the overall TWF and for waste storage buildings. Based on the analysis, LANL has proposed to reduce the total TWF MAR from 30,000 PE Ci to 21,400 PE Ci, and the waste storage buildings from 4,550 PE Ci to 3,200 PE Ci each. The recommendation balances program requirements, operational considerations, facility construction cost, and container costs. To implement the reduced MAR strategy above, the Los Alamos Field Office and LANL will need to work with WIPP to ensure two characterization/shipment campaigns are scheduled each year.

The MAR requirement for the interim capability and the enduring capability is different because of the total source term expected to be staged in each of the facilities. Essentially, Area G manages more drums and will have a larger source term. The Los Alamos Field Office request to reevaluate MAR limits and key safety-basis parameters recognizes how the ties between the key safety systems and acquisition cost of the new TWF are intimately linked. For instance, in the first draft of the PDSA, LANL used an average DE loading limit of 30 PE Ci for accident scenarios involving less than 10 drums. The rationale was based on the *Analysis of the TRU Waste Source Term Data*, which calculated an average drum loading of 19.2 PE Ci and was 80% combustible. To ensure that the safety basis calculation was considered to be conservative, the drum loading was increased by 50% to 30 PE Ci. However, at current loading restrictions for waste containers, this value is neither probable for most packages nor possible for certain isotopes of nuclear waste that meet disposal (i.e., WIPP-WAC) requirements. Thus, the analysis in this document included a review of historical trends and potential future scenarios in activity loading for enduring waste to identify the expected normal operational activity loading range.

The first part of the MAR analysis resulted in a newly defined range of activity of 10.5-18.0 PE Ci per DE expected for the design life of the new TWF. For accident scenario analysis it is assumed however that drums will be at the 80 PE Ci limit. This activity loading is assumed because there are no controls in place to ensure that drums are not loaded at the maximum WIPP-WAC of 80 PE Ci. The accident scenario analyses are intended to bound the potential impacts, and are not intended to be based on normal operational ranges.

The Field Office also specifically requested that LANL evaluate a potential reduction of the facility MAR Limit by a factor of up to three. LANL used the newly defined MAR range of 10.5-18.0 PE Ci/DE to define an upper and lower MAR boundary requirement using three containerization scenarios. The result of the analysis showed that the most probable scenario of future operations that balances costs, drum packaging efficiency, and shipment efficiency will routinely require the use of one-third to two-thirds of the MAR limit for each building. This result, paired with scenarios that could potentially provide short term MAR increases, provides evidence demonstrating that the MAR can be reduced from 4,550 PE Ci to 3,200 PE Ci for individual storage buildings (a reduction of 30%).

The difference in waste composition distribution required explanation as well. Waste composition includes the relative fraction of waste volumes that is combustible, non-combustible but dispersible, and non-combustible and non-dispersible. The PDSA submittal contained combustibility values for enduring waste that appeared relatively high compared to Area G. The analysis provided the basis for the initial combustibility values established in the PDSA and evaluated the recent data against PDSA assumptions. Although the recent data provided combustibility values that were much smaller than the PDSA assumptions (27% versus 80% in PDSA), the analysis shows that there is variability in combustible loading over time. For accident scenarios, the material composition distribution for waste containers will be included in the MAR requirement by assuming all waste is combustible. For operations and programs, it is better to assume 100% combustibles and maintain flexibility for waste generator containerization rather than to maintain a requirement for administrative controls of combustible loading. Furthermore, the use of administrative controls to manage or support safety class and/or safety significant system requirements is often perceived as insufficient. Reduction in MAR is the first consideration in the DOE hierarchy of control. This paper provides justification for the logic behind the MAR requirement for the TWF site and waste storage building limits.

Attachment A:
Los Alamos Field Office Comparison of Area G and TWF Safety Basis Parameters

Table 1: Comparison of Area G (TA-54) and TWF (TA-63) key safety basis parameters - 12/3/12

Parameter	Area G (TA-54)	TWF (TA-63)	Ratio: Area G/TWF
Reference:	BIO - ABD-WFM-001.Rev.1.1	PDSA, Rev. 0, 102355-PDSA-001	
Age	58 years, until 2015 - limited life	New Facility	
Distance to the Public	0.24 km / 0.15 mi [pg 28]	1.47 km / 0.91 mi [pg 22]	0.16
Xi/Q (sec/m3) - Ground level release	8.66E-04 sec/m3	1.01E-04 sec/m3	8.6
Dose Conversion Factor- Max. Exposed Off-site Individual (MEOI)	53.3 rem/PE-Ci	6.17 rem/PE-Ci	8.6
Dose Conversion Factor - Collocated Worker	450 rem/PE-Ci	213.7 rem/PE-Ci	2.1
Reference:	[pg 184]	[pg 111-112]	
Functions	Receive, process, store, ship, and dispose LLW, MLLW, T, TRU waste [pg 7]	Receive, characterize, and store TRU waste [pg 15]	TWF does not open, process, or dispose
Facility container inventory	The above-ground inventory: ~ 15,000 TRU waste containers (2009); [pg 8]	825 DE contingency:1240 DE [pg 5]	12 to 18
Facility Rad Inv. (Ci)	150,000	30,000	5
Building Limit (Ci)	25,000	4,550	5.5
POC (Ci)	1800 *	1800 *	1
Transport / OWB (Ci)	1,100	1,100	1
SWB Limit (Ci)	560 *	560 *	1
Drum Limit (Ci)	80 *	80 *	1
Drum Limit (fge)	200 *	200 *	1
Drum median	1		
Drum mean	8		
Drum 95th percentile	31		
Drum Typical		30	
Reference:	[pg 175, pg 1359]	[pg 109, 115]	
* - limit for WIPP compliant containers			
Waste composition distribution			
Combustible	14%	80%	0.18
Dispersible Non-Combustible	13%	4%	3.3
Non-Dispersible Non-Combustible	73%	15%	4.9
Reference:	Table 3-20 [pg 177]	[pg 109]	

Attachment B:
Analysis of the TRU Waste Source Term Data

Los Alamos
NATIONAL LABORATORY
EST. 1943

memorandum

Waste and Environmental Services, FFS

To/MS: M. E. Pansoy-Hjelvik, SB-EWM, E578
Daniel J. Schmitt, OS-BSI, G731
Thru/MS: Robert L. Dodge, WES-FFS, E501
Andrew J. Montoya, WES-WTS, J971
From/MS: Edward D. Derr, WES-FFS, E501
Phone/Fax: 5-6151/Fax 5-8190
Symbol: WES-FFS-10-0004
Date: July 20, 2010

Subject: Analysis of TRU Waste Source Term Data

At your request, an analysis of TRU waste generated at TA-55 and CMR was conducted to determine waste container source terms and waste matrix percentages for use in safety basis calculations for the proposed new TRU Waste Facility. A comparison of the outcome of this analysis to the analysis performed by Robert L. Griffis, ES-EWMO, and documented in Conduct of Engineering Calc No. CAL-10-TA55-AREAG-007, Rev No,: 0 was also performed.

Methodology

Data sets from two separate database queries performed by Kapil K. Goyal, WES-WGS, were used to perform this analysis. The first data set, identified here as Goyal1, was compiled in the second quarter of FY09 and includes data on all TRU waste containers generated during the ten year time period from FY1999 through FY2008. The second data set, identified here as Goyal2, was compiled in July 2010 and includes data on all TRU waste containers generated during the most recent five year time period from July 1, 2005 through June 30, 2010. Container source term data from these two data sets were analyzed and then compared to the source term data in the Griffis report in an effort to determine an "average" container source term that might be used for SB calculations.

The same data sets were analyzed in order to bin TRU waste containers into broad waste matrix categories. Kapil2 lists TRUCON Codes for each waste container that was used to bin the containers into appropriate categories. The matrix percentages were then compared to those in the Griffis report in an effort to determine "average" container waste matrices that might be used for SB calculations.

For consistency, the same three waste matrix categories used in the Griffis report were used here, namely:

- Combustible: mixed heterogeneous waste, HEPA filters, leaded gloves, organics on vermiculite, debris waste, etc.
- Non-Combustible, Dispersible: metal, small tools, miscellaneous equipment, glass, non-cemented organics, gloveboxes, etc.
- Non-Combustible, Non-Dispersible: cemented aqueous waste, solidified inorganics, etc.

Results of the analysis of source term data from Goyal1 and Goyal2 compared to Griffis are shown in Table 1. Results of waste matrix analysis from Goyal2 are tabulated in Table 2. Table 3 compares waste matrix percentages from Goyal2 to Griffis. It should be noted that the source data for both Kapil data sets and the Griffis report is the same; the Waste Management System (WMS) database or the WMS data that was converted into the new Waste Characterization and Tracking System (WCATS) database.

Limitations

Analysis of the data over the past eleven years shows that there is no year to year consistency in TRU waste generation rates, container source terms, or waste matrix types. Therefore, using an "average" year is not likely to be a valid assumption for SB calculations. For example, average annual container source terms vary from a low of 5 PECi/container in FY2001 to more than 21 PECi/container in FY2007. This variability is due to year to year differences is the type and quantity of programmatic work being performed, facility availability, DOE discard authorizations, and other influences such as safety pauses.

Binning the TRU waste into waste categories by use of TRUCON codes is inherently conservative. For example, TRUCON code LA125 is a waste category of mixed combustible and non-combustible waste. For the purpose of this analysis, LA125 was assumed to be 100% combustible. Additional database queries could be performed, if necessary, to drill down below the TRUCON code to better identify specific container contents to reduce the conservative assumptions in this analysis.

A limitation in the Griffis report for newly generated TRU waste is that the data analysis used only FY2009 data to forecast TRU waste generation rates for FY2010 and 2011. A conservative assumption was also added that forecasted source terms would be 150% of the FY2009 average. Although this is a valid assumption for the purposes of the Griffis report, for comparison to the Goyal data sets, this conservative assumption was removed and actual source term data from FY2009 was compared.

Source Term Analysis

Table 1 shows the comparison of container source terms calculated from the Goyal data sets to those in the Griffis report. Note that the 150% conservancy for Total PECi in the Griffis report was reduced by 50% to make a more consistent comparison with the Goyal report.

Table 1: Source Term Comparisons

Source Data	Years	Number of Containers	Total PECi	Average PECi per Container	Highest Annual PECi per Container
Goyal1 (WMS)[1]	1999-2008	3565	43,749	12.3	21 (2007)

Goyal2 (WCATS)[2]	7/05-6/10	2232	40,245	18.0	-
Griffis (WMS)[3]	2009 to forecast 2010 and 2011	Forecasted 2000	38,400	19.2	-

[1]Goyal1 used actual data for the 10 years indicated. Several of these years were low container source term years due to programmatic variables. Therefore, the average PECi/container is skewed low as compared to more recent year generation rates reported in Goyal2.
[2]Goyal2 used actual data for the most recent 5 years and most accurately describes the latest TRU waste activity.
[3]Griffis report conservatively increased the FY2009 total PECi by 150% to 57,400 PECi. That value was decreased by 50% to the 38,400 PECi indicated in the table.

Analysis of this data show good agreement between the Griffis report and Goyal2. Using 20 PECi/container would be a reasonable "average" value for newly generated TRU waste container source term.

Waste Matrix Analysis

Table 2 shows an analysis of Goyal2 data for the past five years binned into waste categories based on TRUCON codes.

Table 2: Waste Matrix Analysis (Goyal2)

TRUCON Code	TRUCON Summary Description	Assigned Matrix Category	No. Containers	% of Total Containers (2232 Total)	Total PECi per TRUCON	Avg. PECi per Container
LA112	Absorbed organic liquid	Combustible	Drums: 18	0.8%	18.6	1.0
LA114	Cemented waste	Non-Combustible/ Non-Dispersible	Drums: 125	5.6%	1558.7	12.5
LA115	Graphite	Combustible	Drums: 1	0.0%	2.4	2.4
LA117	Metals	Non-Combustible/ Dispersible	SWB: 1	0.0%	2.3	2.3
LA122	Solid inorganic waste	Non-Combustible/ Dispersible	Drums: 50 POC's: 20	3.1%	5089.4	72.7
LA124	Pyrochemical	Non-Combustible/	Drums: 347	20.8%	6120.2	13.2

	salts	Non-Dispersible	POC's: 118			
LA125	Mixed combustible/Non-combustible debris	Combustible	Drums: 1438 POC's: 29 SWB: 13 Other: 6	66.6%	25,408.5	17.1
Not assigned	Undetermined	Undetermined	Drums: 57 POC's: 3 Other: 6	3.0%	2044.5	31.0

Analysis of this data show that of those containers in assigned TRUCON codes (2166 containers):

- 69.5% of TRU waste containers are Combustible
- 3.3% of TRU waste containers are Non-Combustible/Dispersible
- 27.2% of TRU waste containers are Non-Combustible/Non-Dispersible

Waste Matrix Comparisons

Table 3 shows the comparisons of waste matrix percentages from analysis of Goyal2 compared to Griffis.

Category	% From Griffis Report	% From Analysis of Goyal2
Combustible	80.0%	69.5%
Non-Combustible/Dispersible	4.2%	3.3%
Non-Combustible/Non-Dispersible	15.8%	27.2%

Discussion:

The average PECi/container loading and waste matrix percentages in the Griffis report are based on actual data from only one year (FY2009). The average PECi/container loading and waste matrix percentages from analysis of Goyal2 are actual data for five years (7/1/05 thru 6/30/2010). Containers generated in FY2009 contained slightly higher PECi loadings than average over the five year period in Goyal2. Similarly, containers generated in FY2009 contained slightly higher loading of combustible material than average over the five year period in Goyal2.

If SB personnel want to use actual averages for TRU waste containers, use of the data from the Goyal2 data set should be used. If SB personnel want to use "worst case" for drums generated over the past five years, they should use the data set in the Griffis report.

Distribution
WES-FFS-10-0004

Summary:

Over the past 10 years, generation rates of TRU waste have varied significantly from a low of 163 containers (FY00) to a high of 631 containers (FY07). Similarly, the average PECi loading per container has varied from a low of 5 PECi/container in FY01) to a high of 21 PECi/container in FY07). This variability is caused by fluctuations in programmatic work that generated TRU waste. Also similarly, waste matrix characteristics fluctuate based on what type of programmatic work generates the waste. Forecasts of future TRU waste generating rates and waste characteristics are extremely difficult to predict because of unknown fluctuations in programmatic activity.

It is true, however, that waste generation rates and curie loadings have been increasing over the past several years as compared to the last 10 year averages. Although generation rates are expected to continue to increase over the next several years, limitations on loading TRU waste containers will likely keep the average container loading near the 20 PECi/container level as indicated in both Goyal2 (18.0) and Griffis (19.2).

Waste matrix percentages from Griffis and Goyal2 vary by only 10% based on averages compared to one year (FY2009) values. Amount of conservancy desired in SB calculations will determine whether average or high values should be used.

Waste matrix percentages can be refined further if desired by using more detailed container loading data available in the WCATS database. WES-WTS (Waste Technical Services) is responsible for maintaining all waste data and reporting on that data. WTS should be contacted for additional analysis and future data requests. The mission of WTS is to assure accuracy and consistency in maintaining, analyzing, and reporting waste data at LANL.

Cy:
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WES-FFS File

Attachment C:
Program Requirements

Capability Requirements Summary - Staging and Storage

Capability	Requirements	Constraints
Staging and Storage	Receive prepackaged TRU waste from LANL site generators	• Location within the LANL site boundaries • Contact-handled waste only • Provide unloading capability • Transport waste within restricted/ protected area • Location in close proximity to waste generators may reduce site burdens for transport and closure
	Store TRU waste containers	• Close access to other functional areas • 55-gallon drums and standard waste boxes, 10-drum overpack, 80-gallon overpack, limited storage of oversize boxes • 825 D/DE storage, surge storage of 1,240 D/DE • Approximately 25,000 – 30,000 PE Ci • SWEIS throughput capacity limit 1,500 D/DE • RCRA-qualified storage • Enclosed space, heating and lighting
	Transfer TRU waste containers to and from other functions	• Provide transport
	Inventory and track containers	• Provide required location, content, and holding time information • Conform to regulatory and DOE requirements

Capability Requirements Summary - Characterization and Certification

Capability	Requirements	Constraints
Infrastructure to support mobile trailers owned by CCP	Provide infrastructure capability to support 1,100 D/DE throughput in 9 nine months.	• Agreement with CBFO to perform a minimum of two campaigns per year.
Characterization and Certification Provided by mobile trailers owned by CCP.	Characterize waste containers for physical, radiological, and chemical content	• Throughput capacity of 1,100 drums or drum-equivalents for nine months. • Conduct all assays required for regulatory and waste acceptance criteria
	Certify contents for shipment to WIPP	
	Conduct nondestructive testing	• Process drums and standard waste boxes
	Conduct real-time radiography	• Process drums and standard waste boxes • Provide high-efficiency neutron counter capability • Provide tomographic gamma spectrometer • Provide isotopic analysis • Real-time radiography performed on statistical sample to confirm acceptable knowledge
	Maintain required records	• Drum and standard waste box contents • Calibration verification

Attachment C:
Program Requirements

Capability Requirements Summary – Intra-site Shipping and Receiving

Capability	Requirements	Constraints
Shipping and Receiving	Receive prepackaged TRU waste from LANL site generators via Truck or Tractor-Trailer combination	• Provide inspection to meet facility Waste Acceptance Criteria • Unloading capability
	Ship TRU waste containers	• Load transport vehicles
	Recordkeeping	• Track shipping and receiving records

Capability Requirements Summary - Utilities and Support

Capability	Requirements	Constraints
Utilities and Support	Provide utilities and site services: power, water, sanitary, telecommunications, security	
	Support personnel space for operations functions – intermittent	
	Support personnel space for WIPP certification functions	